

CLAIMS

AS PRESENTED JUNE 30, 2003

1 1. (Currently Amended) A method of predicting performance of a customer  
2 line for data transmission, comprises:  
3 making one-ended measurements of measuring electrical properties of the customer  
4 line from a central location;  
5 identifying a line model for the customer line from the measurements;  
6 identifying a modem model for a modem selected for use with the line, the modem  
7 model providing performance data on the selected modem; and  
8 predicting performance data for the customer line when operated with the selected  
9 modem by combining the line and modem models.

1 2. (Original) The method of claim 1, wherein the performance data comprises a  
2 data transmission rate.

1 3. (Original) The method of claim 2, further comprising:  
2 predicting whether the customer line is disqualified for data transmission; and  
3 wherein the act of predicting performance data is in response to predicting that the  
4 line is not disqualified.

1 4. (Original) The method of claim 1, wherein the act of measuring includes  
2 using the measurements to evaluate at least one admittance of the customer line at a plurality  
3 of frequencies.

1 5. (Original) The method of claim 4, wherein the act of measuring includes  
2 finding at least two of  $Y_{tr}$ ,  $Y_{rg}$ , and  $Y_{tg}$  for the customer line.

1 6. (Original) The method of claim 5, wherein the act of identifying a line model  
2 comprises:  
3 determining a frequency dependent attenuation from the admittances; and  
4 determining a normalized line length from the frequency dependent attenuation.

1 7. (Original) The method of claim 4, wherein the act of identifying a line model  
2 comprises:

3 determining whether the customer line has a bridged tap.

1 8. (Original) The method of claim 1, wherein the act of identifying a line model  
2 includes finding a frequency dependent line attenuation from the measurements.

1 9. (Original) The method of claim 1,  
2 wherein the act of measuring includes driving the customer line with a signal at a  
3 plurality of frequencies; and

4 the act of identifying a line model includes evaluating a property of the customer  
line for frequencies high with respect to the frequencies of the signal.

1 10. (Original) The method of claim 1, wherein the act of measuring includes  
2 finding a noise level, a capacitance, and frequency dependent admittances for the customer  
3 line.

1 11. (Original) The method of claim 2, wherein the modem model indexes  
2 predicted data rates by an averaged normalized line length and a noise level of the customer  
3 line.

1 12. (Previously Amended) A method of speed qualifying a customer line for  
2 data transmission, comprises:

3 identifying a proxy line in a cable carrying the customer line;  
4 performing one-ended electrical measurements on the proxy line; and  
5 predicting a data rate for the customer line from the measurements.

1 13. (Original) The method of claim 12, wherein the act of predicting a data rate  
2 further comprises:

3 identifying a line model for the proxy line from the measurements;  
4 identifying a modem model for a modem to use with the customer line; and  
5 combining the modem model with the line model to obtain the data rate.

1 14. (Original) The method of claim 13, wherein the act of identifying a line  
2 model includes finding at least two of  $Y_{tr}$ ,  $Y_{rg}$ , and  $Y_{tg}$  for the proxy line at a plurality of  
3 frequencies.

1 15. (Original) The method of claim 14, further comprising one of inferring a mix  
2 of wire gauges and inferring the presence of a bridged tap from the found admittances.

1 16. (Original) The method of claim 14, wherein the act of identifying a line  
2 model includes finding a frequency dependent line attenuation from the measurements.

1 17. (Original) The method of claim 12,  
2 wherein the act of performing includes driving the proxy line with a signal having a  
3 plurality of frequencies; and  
4 the act of identifying a line model includes evaluating a property of the proxy line  
5 for frequencies high with respect to the frequencies of the signal.

1 18. (Previously Amended) The method of claim 13, wherein the modem model  
2 indexes predicted data rates by an averaged normalized line length and a noise level of the  
3 customer line.

1 19. (Previously Amended) A method of marketing telephone lines to  
2 customers, comprising:  
3 speed pre-qualifying a plurality of the customer lines using one-ended electrical  
4 measurements performed from a central location; and  
5 setting billing rates of at least a portion of the lines at prices that depend on the speed  
6 qualification of the portion;  
7 wherein at least a portion of the acts of speed qualification include performing electrical  
8 measurements on a proxy line.

20. Cancelled

1 21. (Original) The method of claim 19, further comprising:  
2 monitoring a portion of the customer lines after being placed in service by

3 repeatedly performing one-ended electrical measurements on the portion; and  
4 determining new data rates of each line of the portion from the repeated  
5 measurements.

1 22. (Original) The method of claim 19, wherein each act of speed pre-qualifying,  
2 comprises:

3 measuring electrical properties of one of the lines from the central location;  
4 identifying a line model for the one of the lines from the measured electrical  
5 properties;  
6 identifying a modem model for a modem to use with the one of the lines, the modem  
7 model to provide rate data on the selected modem; and  
8 predicting a data rate for the one of the lines when operated with the selected modem  
9 by combining the line and modem models.

1 23. (Original) The method of claim 22, the act of speed pre-qualifying the one of  
2 the lines further comprising:

3 predicting whether the one of the lines is disqualified for data transmission; and  
4 wherein the act of predicting a data rate is in response to predicting that the one of  
5 the lines is not disqualified.

1 24. (Previously Amended) A method of marketing telephone lines to  
2 customers, comprising:

3 speed pre-qualifying a plurality of customer lines from one-ended electrical  
4 measurements made by a test unit switchably connected to the plurality of customer lines,  
5 the speed pre-qualifying including classifying the lines for at least high speed digital service  
6 or low speed digital service; and

7 selectively offering the high-speed service to at least a portion of the customers  
8 having lines qualified to support high-speed digital service;

9 wherein each act of speed qualifying comprises:

10 measuring electrical properties of one of the lines from the central location;  
11 identifying a line model for the one of the lines from the electrical properties;  
12 identifying a modem model for use with the one of the lines, the modem  
13 model providing data rates for the selected modem; and

14 predicting a data rate for the one of the lines when operated with the selected  
15 modem by combining the line and modem models.

25. Cancelled

1 26. (Previously Amended) A method of marketing telephone lines to  
2 customers, comprising:  
3 speed pre-qualifying each line for high-speed digital service or low-speed digital  
4 service by using one-ended electrical measurements;  
5 receiving requests for high-speed digital data service from customers; and  
6 connecting at least a portion of the lines qualified for high-speed digital service to  
7 customers requesting high-speed digital service in response to receiving said requests;  
8 wherein at least a portion of the measurements are performed on a proxy line.

1 27. (Original) The method of claim 26, wherein each act of speed pre-qualifying  
2 comprises:  
3 measuring electrical properties of one of the lines from the central location;  
4 identifying a line model for the one of the lines from the electrical properties;  
5 identifying a modem model for use with the one of the lines, the modem model  
6 providing transmission rate data on the selected modem; and  
7 predicting a data rate for the one of the lines when operated with the selected modem  
8 by combining the line and modem models.

28. Cancelled

29. Cancelled

1 30. (Previously Amended) The system of claim 31, wherein the computer is  
2 adapted to:  
3 identify a line model for the selected line from the measurements thereon;  
4 identify a modem model for use with the selected line; and  
5 predict a data rate for the selected line when operated with the selected modem by  
6 combining the line and modem models.

1           31. (Previously Amended) A system for characterizing performance of  
2 customer lines for data transmission, comprising:

3           a computer;

4           a telephony switch, coupled to a portion of the lines and adapted to connect the  
5 portion to a network, to perform one-ended electrical measurements on the portion, and to  
6 transmit the measurements to the computer;

7           a measurement unit coupled to the switch and computer, the unit to make the  
8 measurements on a selected line at a lower frequency in response to receiving a command  
9 from the computer, the computer to predict data rates at a higher frequency for the selected  
10 line from the measurements, the computer being further adapted to:

11           predict whether the selected line is disqualified for data transmission from the  
12 measurements thereon;

13           wherein:

14           the computer is adapted to determine a frequency dependent attenuation  
15 from the measurements; and

16           the computer is adapted to command the measurement unit to order  
17 measurements on proxy lines and to predict data rates for a portion of the customer lines by  
18 using the measurements on the proxy lines.

32.       Cancelled

33.       Cancelled

1           34. (Currently Amended) A program storage device encoding an executable  
2 program for a method of speed qualifying telephone lines for data transmission, the method  
3 comprising:

4           ~~measuring making one-ended measurements of~~ electrical properties of a customer  
5 line from a central location;

6           identifying a line model for the customer line from the measurements;

7           identifying a modem model for use with the line, the modem model providing data  
8 rates of the selected modem; and

9 predicting a data rate for the customer line when operated with the selected modem  
10 by combining the line and modem models.

1 35. (Original) The device of claim 34, the method further comprising:  
2 predicting whether the customer line is disqualified for data transmission; and  
3 wherein the act of predicting a data rate is performed in response to predicting that  
4 the line is not disqualified.

1 36. (Original) The device of claim 34, wherein the act of measuring includes  
2 finding at least one admittance of the customer line at a plurality of frequencies by using the  
3 measurements.

1 37. (Original) The device of claim 36, wherein the act of measuring includes  
2 finding at least two of  $Y_{tr}$ ,  $Y_{rg}$ , and  $Y_{te}$  for the customer line.

1 38. (Original) The device of claim 36, wherein the act of identifying a line  
2 model includes finding a frequency dependent line attenuation from the measurements.

1 39. (Original) The device of claim 36, wherein the act of identifying a line  
2 model comprises:  
3 determining a frequency dependent attenuation from the admittances; and  
4 determining a normalized line length from the frequency dependent attenuation.

1 40. (Original) The device of claim 34, wherein the modem model lists predicted  
2 data rates by averaged normalized line length and noise level of the customer line.

1 41. (Original) The device of claim 40, the method further comprising:  
2 modifying the predicted data rate in response to a value of one or more quality  
3 parameters, the values characterizing the selected modem.

1 42. (Original) The device of claim 41, wherein the parameters are selected from  
2 the group consisting of impulse noise compensation, noise floor, echo compensation and  
3 phase instability compensation.

1 43. (Original) The device of claim 34, the method further comprising:  
2 identifying the customer line as a proxy line for a second telephone line; and  
3 predicting a data rate for the second line from the data rate predicted for the proxy  
4 line.

1 44. (Original) A method of determining the attenuation of a customer's  
2 telephony line, comprising:  
3 performing a plurality of one-ended measurements of frequency dependent  
4 admittances of the customer's telephony line, the measurements being performed in a first  
5 frequency range;  
6 processing the measurements by a set of logical decision trees; and  
7 adjusting values of a frequency-dependent attenuation for an average telephony line  
8 to predict an attenuation of the customer's telephony line in a second frequency range, the  
9 act of adjusting being responsive to results from the logical decision trees.

1 45. (Original) The method of claim 44, wherein the act of performing includes  
2 finding at least two of  $Y_{tr}$ ,  $Y_{tg}$ , and  $Y_{tg}$  for the customer's telephony line.

1 46. (Original) A method of determining performance of a customer telephone  
2 line, the line having both a tip wire and a ring wire, comprising:  
3 driving one of the two wires with a first alternating voltage at one end and the other  
4 of the two wires with a second voltage at the same end and measuring voltages between  
5 each wire and ground while driving the two wires;  
6 driving the other of the two wires with a third alternating voltage at the same end  
7 and the one of the two wires with a fourth voltage at the same end and measuring voltages  
8 between each wire and ground while driving the two wires;  
9 driving both the tip and the ring wires with a fifth alternating voltage from  
10 the same end and measuring voltages at the tip and ring wires while driving both wires;  
11 and  
12 determining admittance  $Y_{tg}$  at a plurality of frequencies from the measured voltages.

1 47. (Original) The method of claim 46, further comprising:



2 determining an apparent length of the customer line from values of said  
3 admittance at a plurality of frequencies.

1 48. (Original) The method of claim 46, further comprising:  
2 determining whether the customer line has a bridged tap from values of  
3 said admittance at a plurality of frequencies.

1 49. (Original) The method of claim 46, further comprising:  
2 determining the remaining admittances  $Y_{lg}$  and the admittance  $Y_{lt}$  at a plurality of  
3 frequencies from the measured voltages.

1 50. (Original) The method of claim 49, further comprising:  
2 determining a frequency-dependent attenuation of the line from the measured  
3 admittances.

1 51. (Original) The method of claim 50, further comprising:  
2 predicting a data rate for the line from the attenuation; and  
3 adjusting the predicted data rate in response to a rating of a gauge mix of  
4 the line.

1 52. (Original) The method of claim 50, further comprising:  
2 determining whether the customer line has a bridged tap from values of  
3 said admittances at a plurality of frequencies;  
4 predicting a data rate for the line from the attenuation; and  
5 adjusting the predicted data rate in response to determining that the customer line  
6 has a bridged tap.

1 53. (Previously Amended) A method of detecting a bridged tap in a customer line,  
2 comprising:  
3 making one-ended electrical measurements over a range of frequencies on  
4 the customer line;  
5 determining one or more admittances as a function of frequency of the  
6 customer line from the measurements; and

7 detecting that the customer line has a bridged tap in response to finding a  
8 the ratio of the imaginary part to the real part of a derivative of admittance as a function  
9 of frequency exceeds a threshold.

1 54. (Previously Amended) The method of claim 53, wherein the method is used in  
2 qualifying a line for high speed data services and the one ended measurements are made  
3 at a range of frequencies that are below the frequency of the high speed data services  
4 signals.

1 55. (Previously Added) The method of claim 53, wherein the one or more admittances  
2 is an admittance between a wire of the customer line and ground.

1 56. (Previously Added) The method of claim 53, wherein the act of making one-ended  
2 measurements performs the measurements through a voice test access of a telephony  
3 switch.

1 57. (Previously Amended) The method of claim 53, wherein detecting comprises:  
2 determining whether a ratio of imaginary and real parts of a frequency  
3 derivative of one of the one or more admittances has a peak; and  
4 wherein the determining is based on finding an above threshold peak in  
5 the ratio.